

Interannual Variations of Surface Radiation

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Objective of Study and Data Set

- To quantify the interannual variations of surface radiation using the NASA/GEWEX SRB Data Set.
- This data set includes Net Shortwave, Upward and Downward Longwave Fluxes with monthly averages on $1^{\circ} \times 1^{\circ}$ grid for 1983-2005.

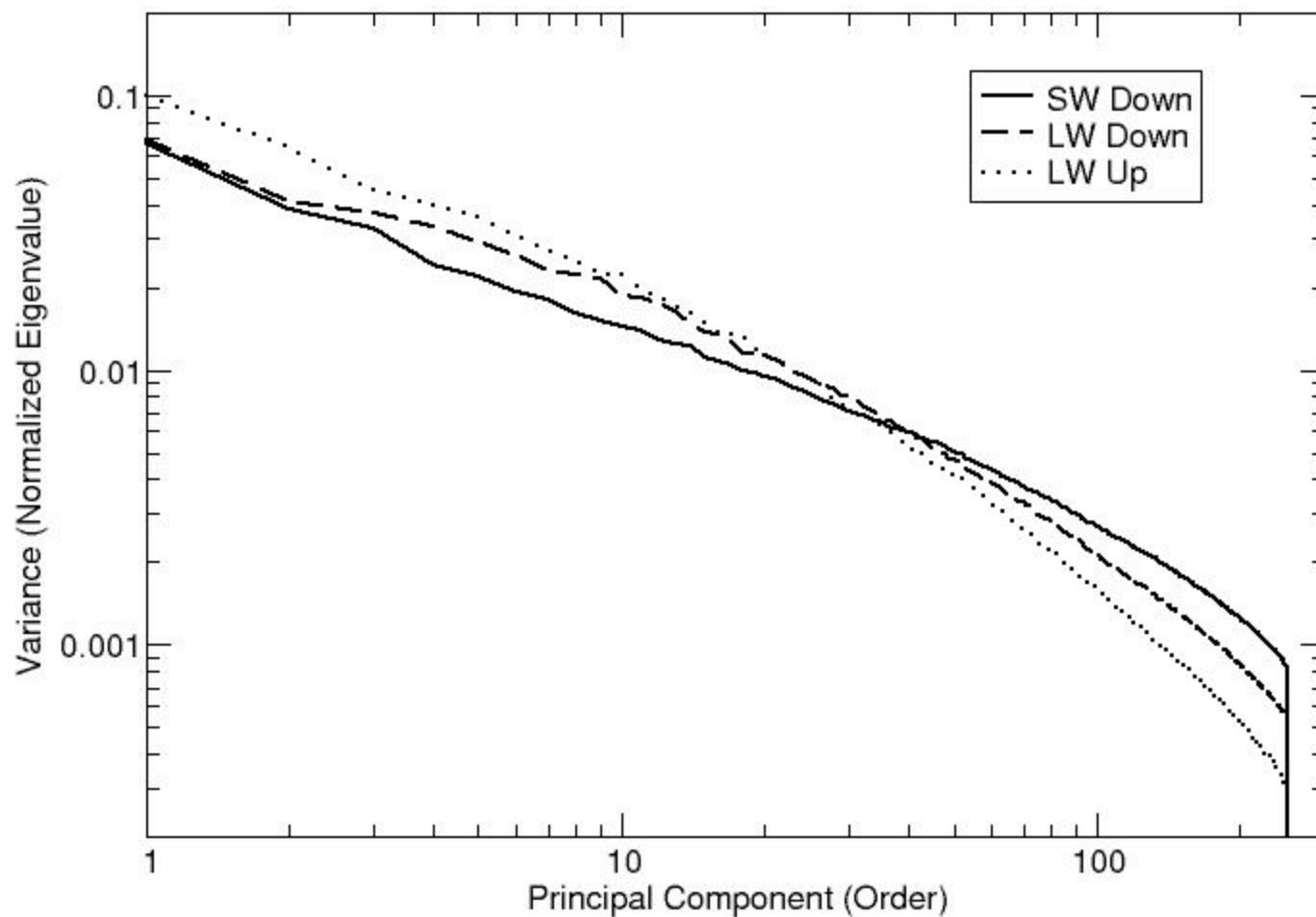
Approach

- Compute climatological mean monthly values.
- Interannual variations are variations of value from the climatological-mean monthly value.
- Use Principal Component Analysis to compute variations as correlated in time.
- These Principal Components are projected onto map to give geographic variations which are correlated in time.

Computations

- Principal Components are eigenvectors of Covariance Matrix of variations.
- Eigenvalues of Covariance Matrix define amount of variance described by each Principal Component.

Variances from PC Analysis of SRB Interannual



Power Law for RMS of Interannual Variations

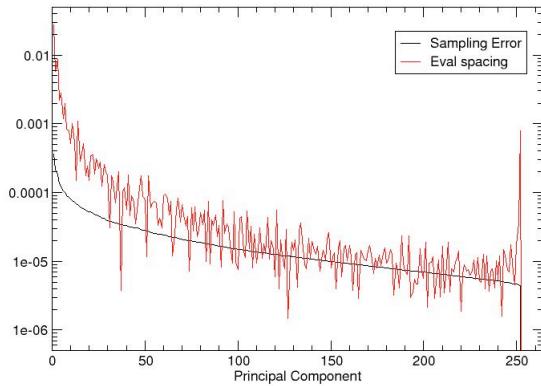
RMS, Shortwave Net $\text{RMS}_n = 3.84n^{-0.32}$

RMS, Longwave Down $\text{RMS}_n = 1.92n^{-0.30}$

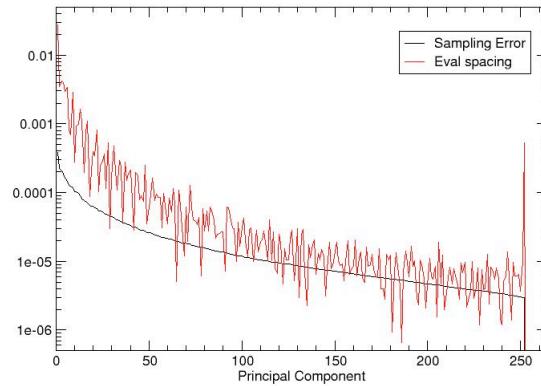
RMS, Longwave Up $\text{RMS}_n = 2.16n^{-0.36}$
W/m²

Parameter	SWD	LWD	LWU
λ_1	0.0663	0.0685	0.1001
m	0.65	0.60	0.73
RMS	14.9	6.8	7.3
RMS(1)	3.84	1.92	2.16
p	0.32	0.30	0.36

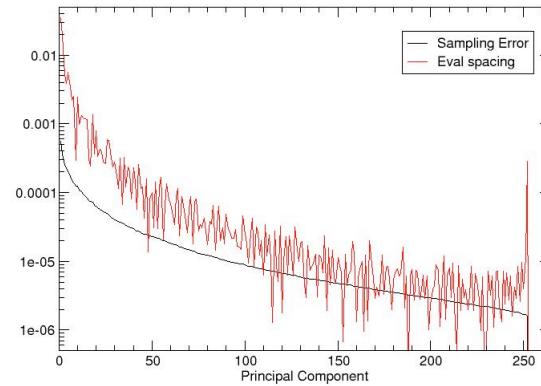
Validity check of Principal Components: North et al. Criterion



Shortwave Down



Longwave Down



Longwave Up

There are ~40 Valid Principal Components
for Each Radiation Flux

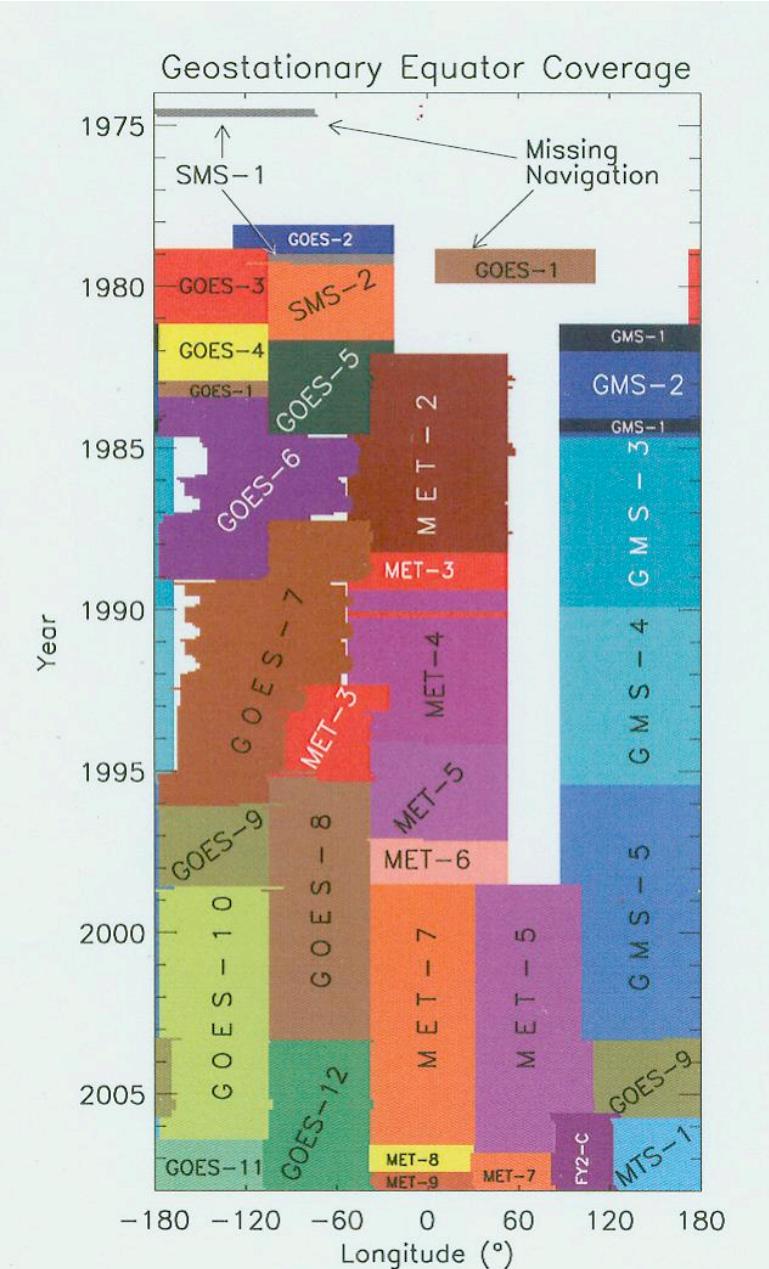


Fig. 1. Time series showing geostationary observations at the Equator.

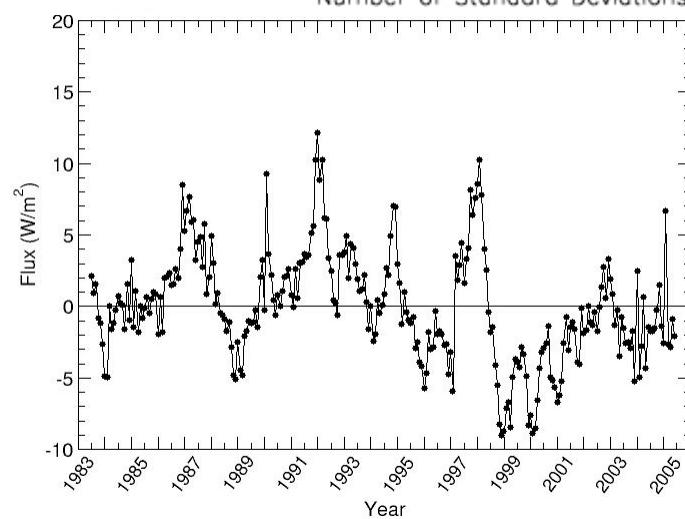
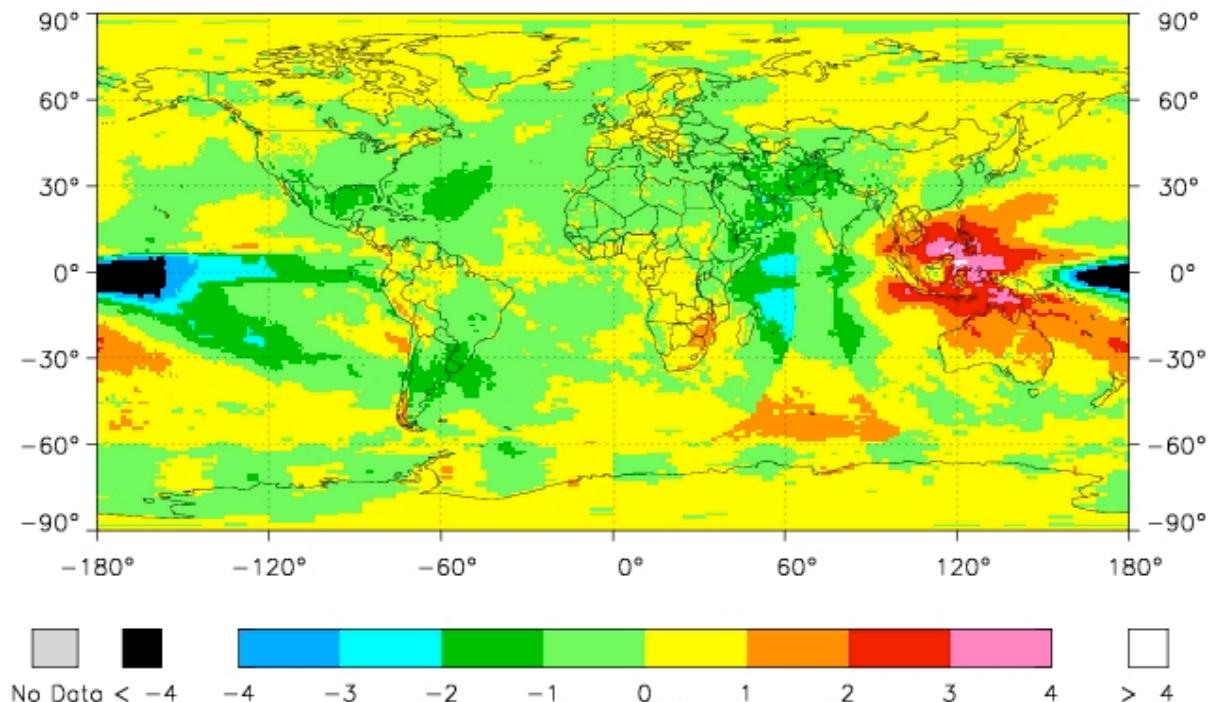
Shortwave Downward Principal Components and EOFs

1	ENSO
2	Artifact due to S/C
3	ENSO North-South variation
4	Indian Ocean Activity
5	Indian Ocean Activity
6	Indian Ocean Activity
7	-
8	Brazil Outflow
9	Indian Ocean and East Eq. Pacific
10	Phillipines

Longwave Downward Principal Components and EOFs

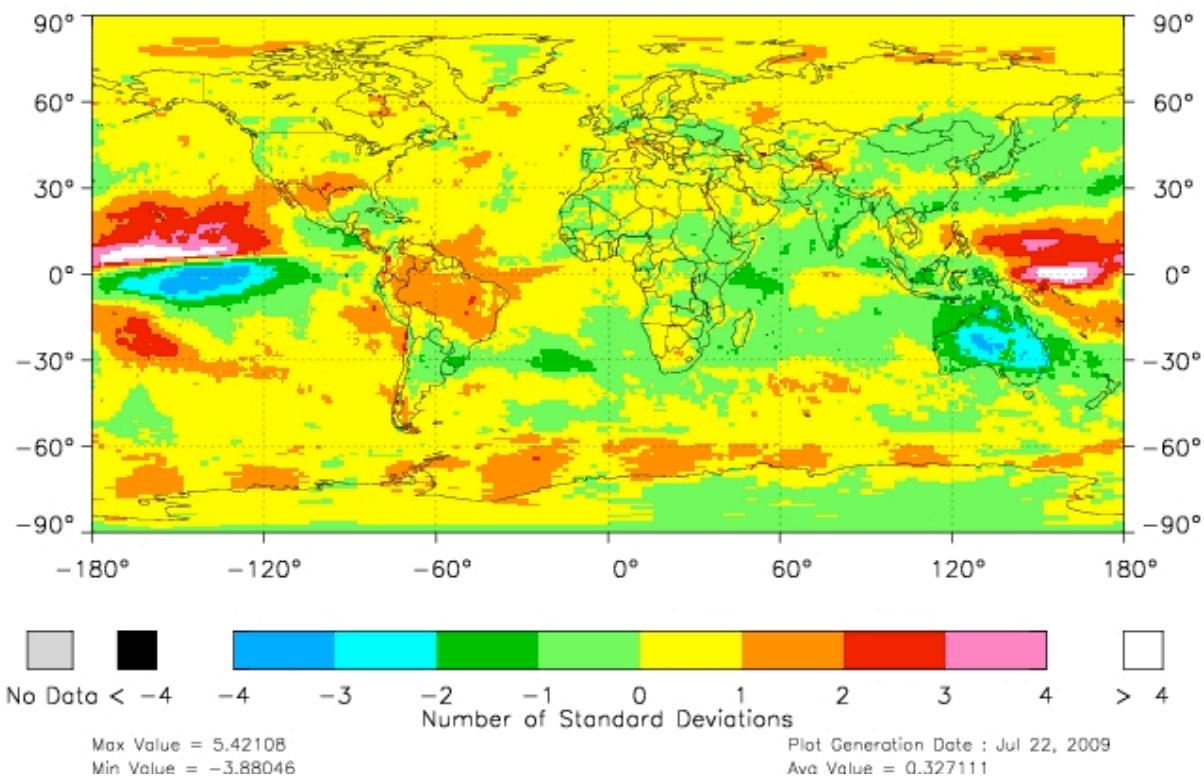
1	ENSO and North Africa
2	N. Africa, E. Siberia, Eq. Pacific
3	Canada & Australia
4	North America and Eurasia
5	High Latitudes North and South
6	High Latitudes North
7	High Latitudes North
8	High Latitudes North and Australia
9	High Latitudes North & Africa/Asia
10	Random Patterns, but mostly all +

EOF-1 Downward Shortwave



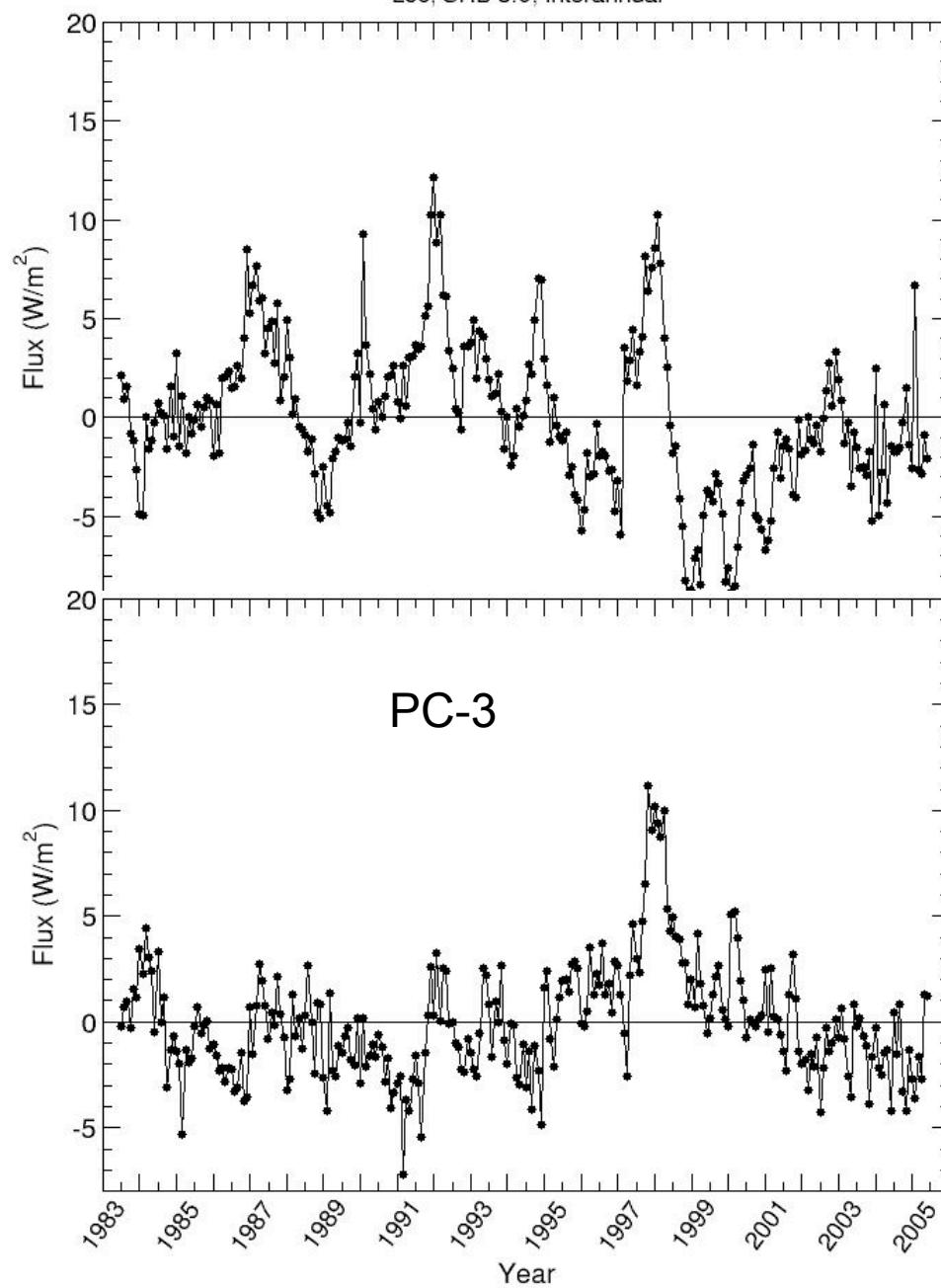
This EOF describes ENSOs
but shows artifacts

SRB EOF-3 land/ocean
Interannual 7/1983 – 6/2005
INPUT FILE: evec_SWdown_loc.dat

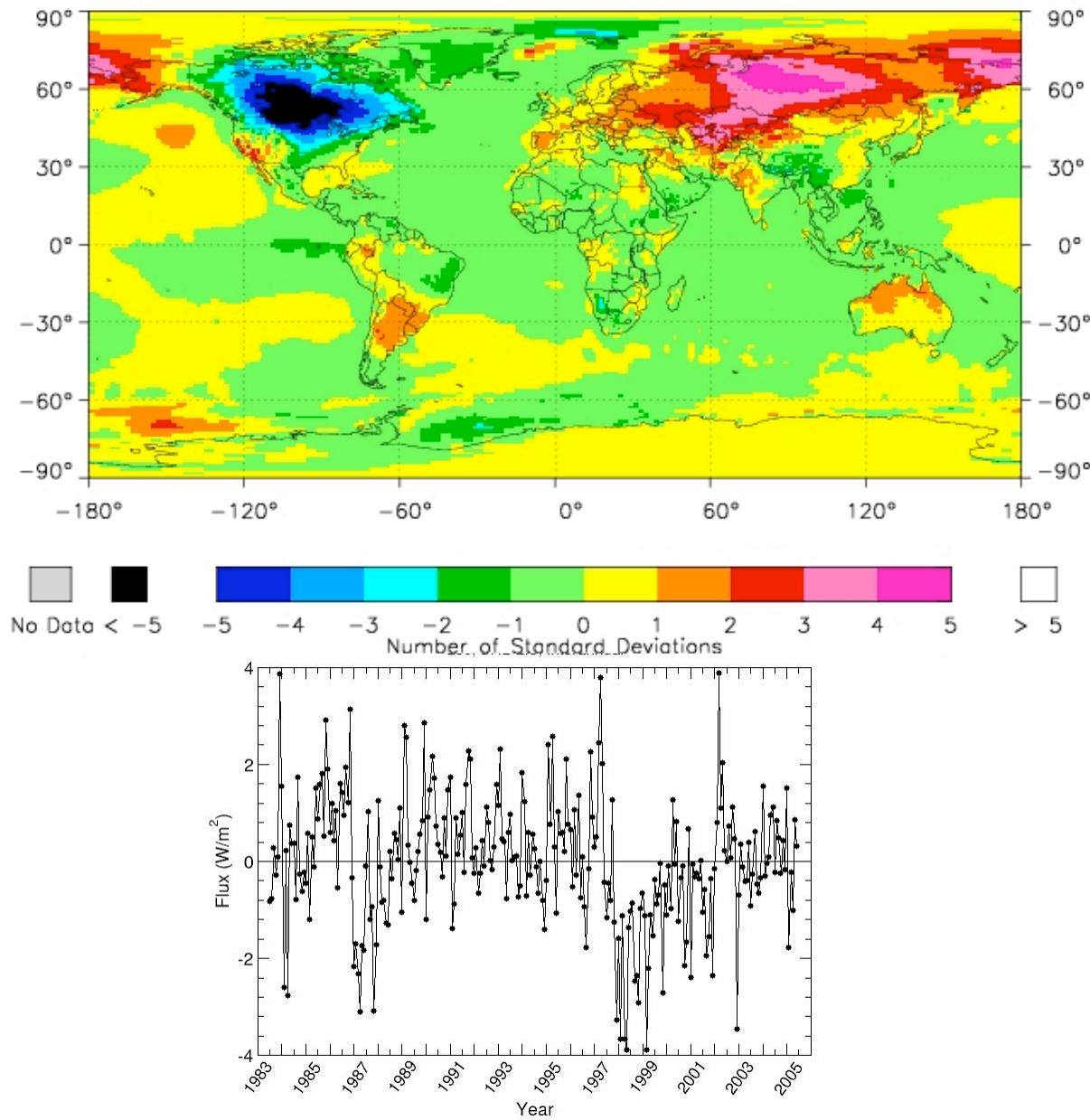


PC-1 for SW Down

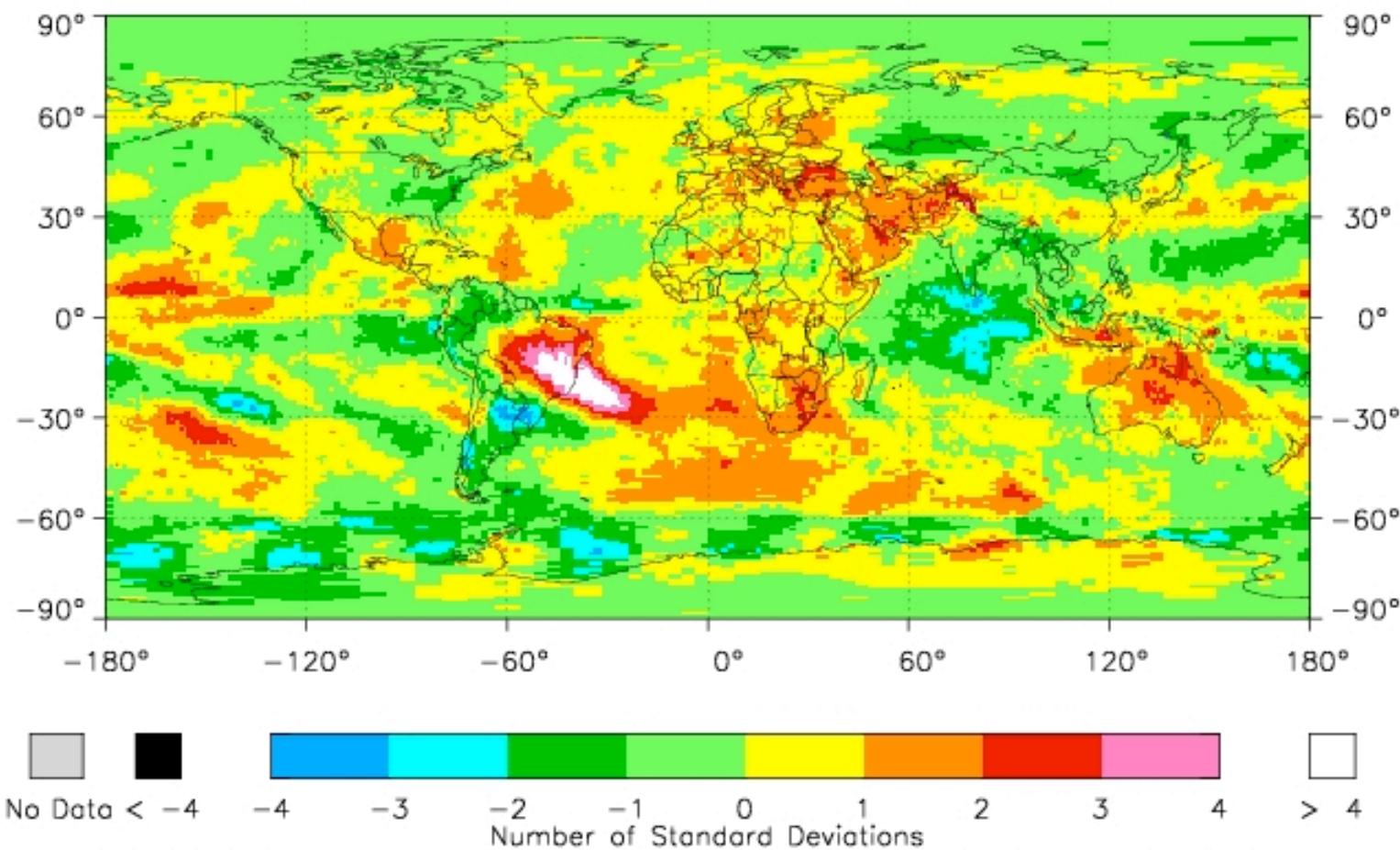
Loc: SRB 3.0; Interannual



EOF-4 for Longwave Up

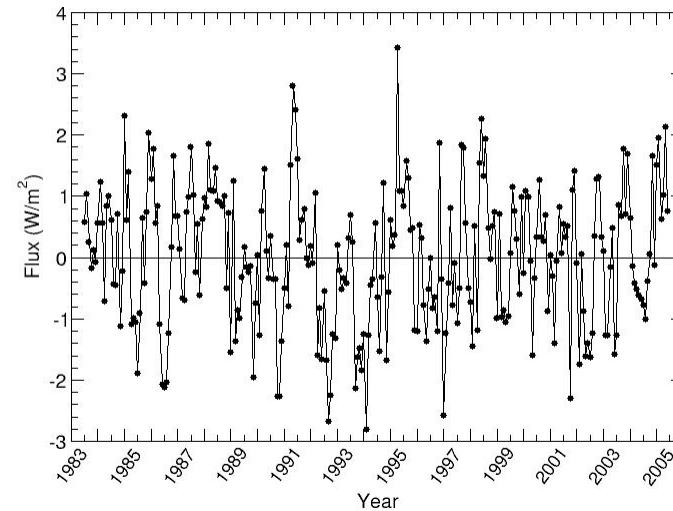
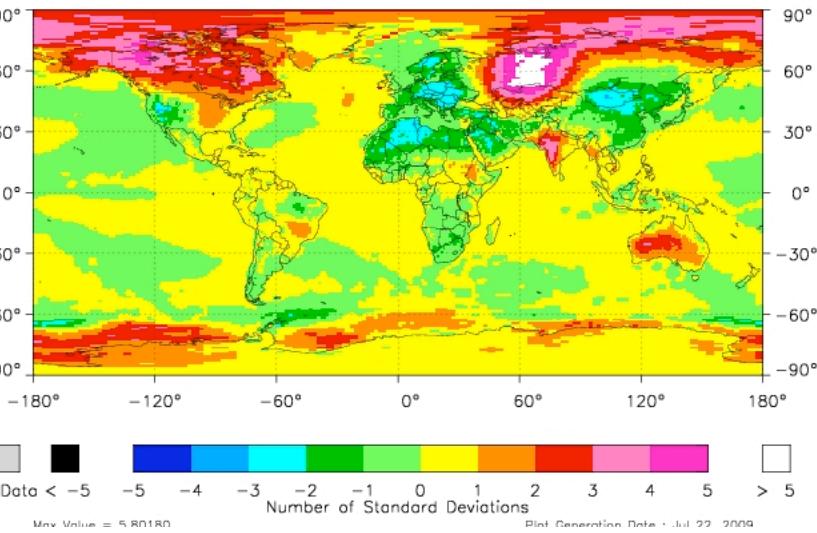
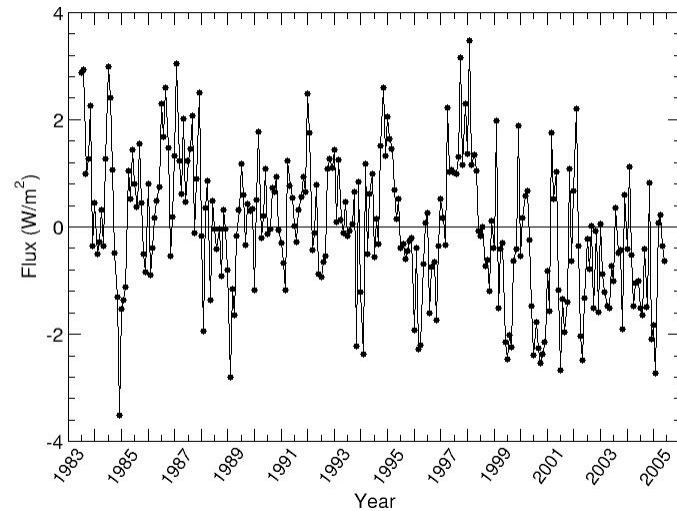
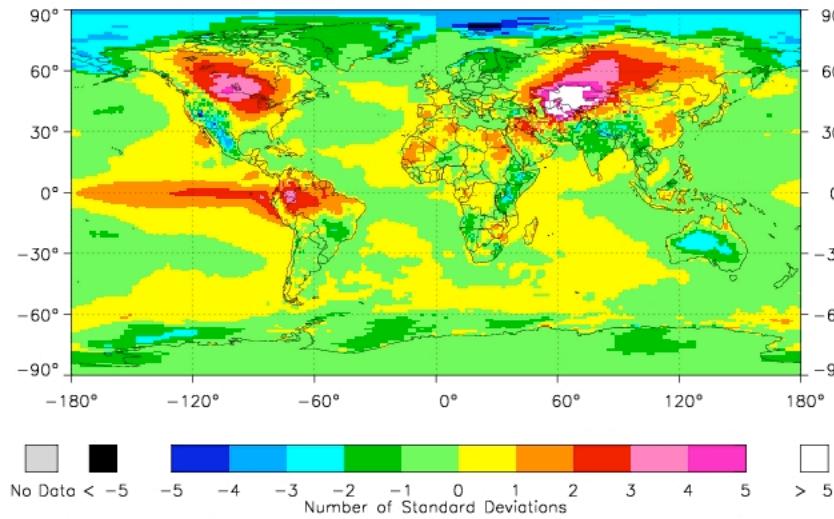


EOF-8 Shortwave Down South Atlantic Convergence Zone

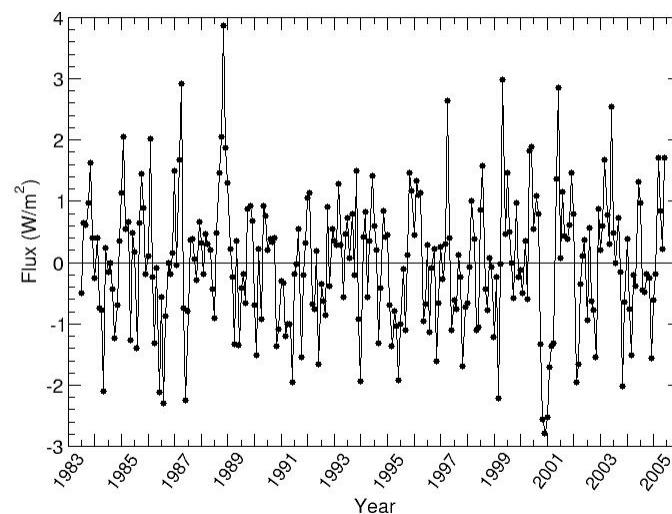
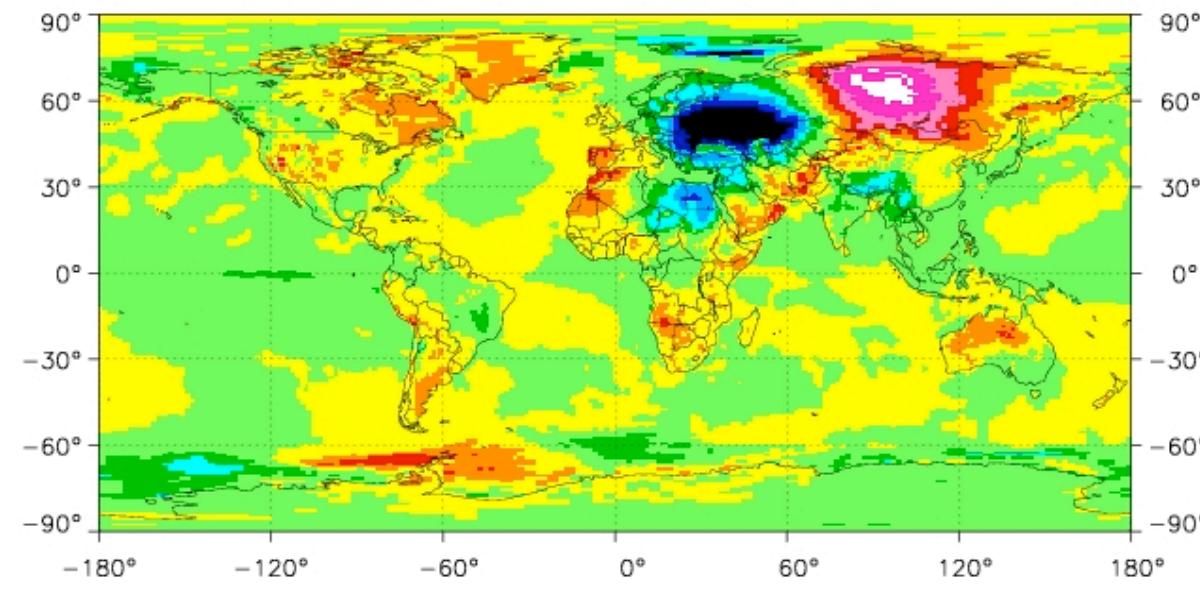


Longwave Up

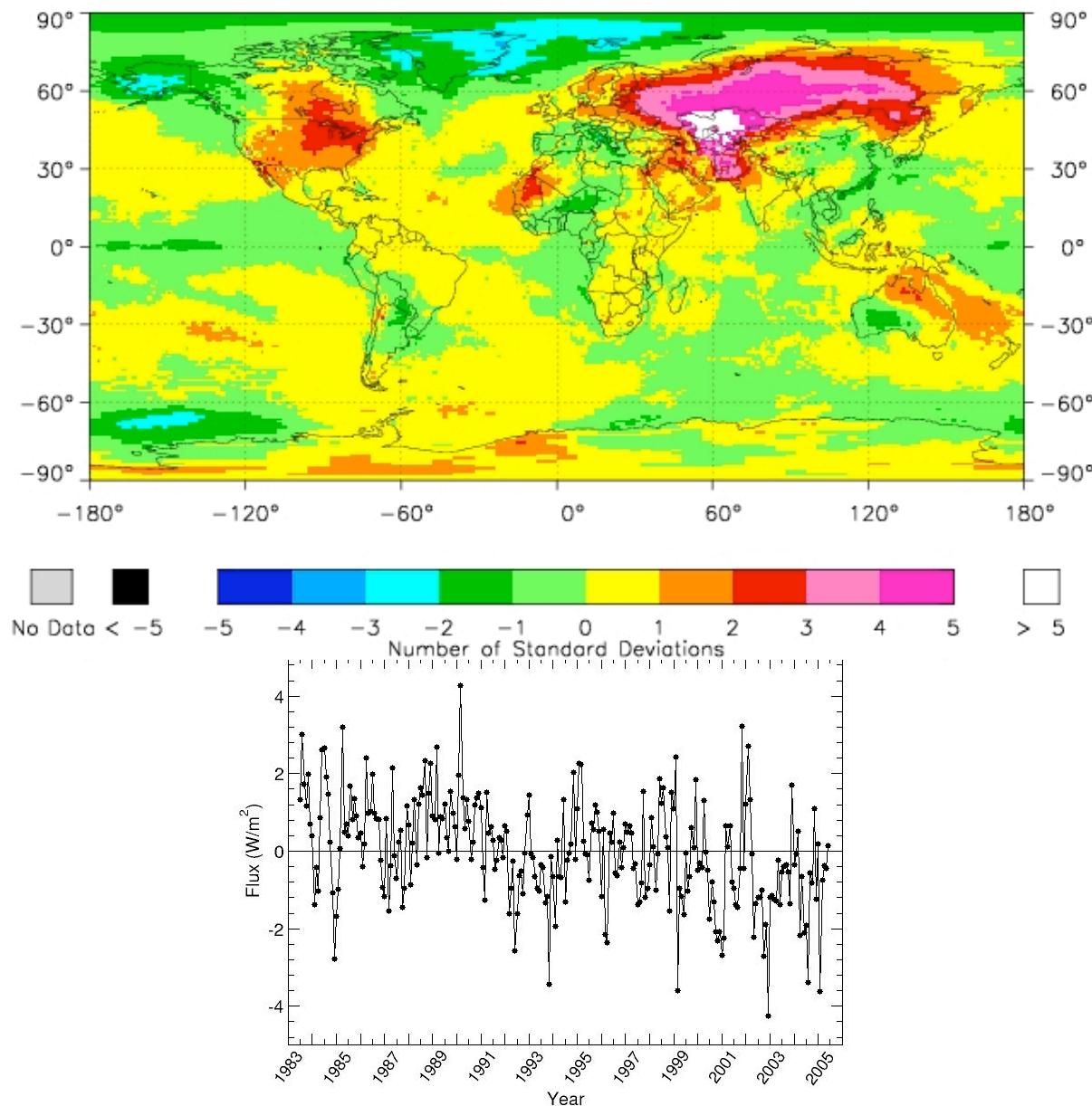
EOF-5 EOF-7



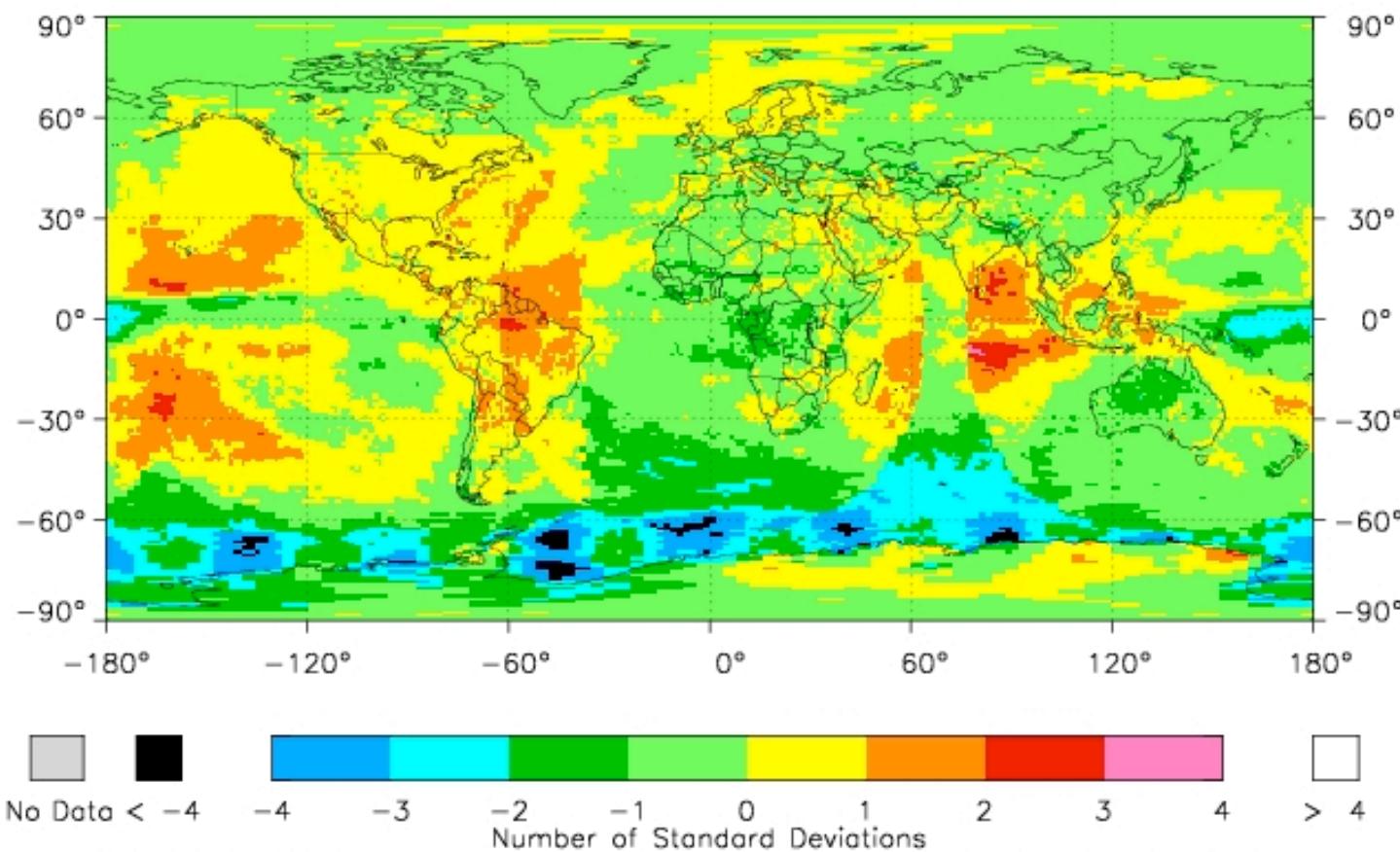
EOF-8: Longwave Up

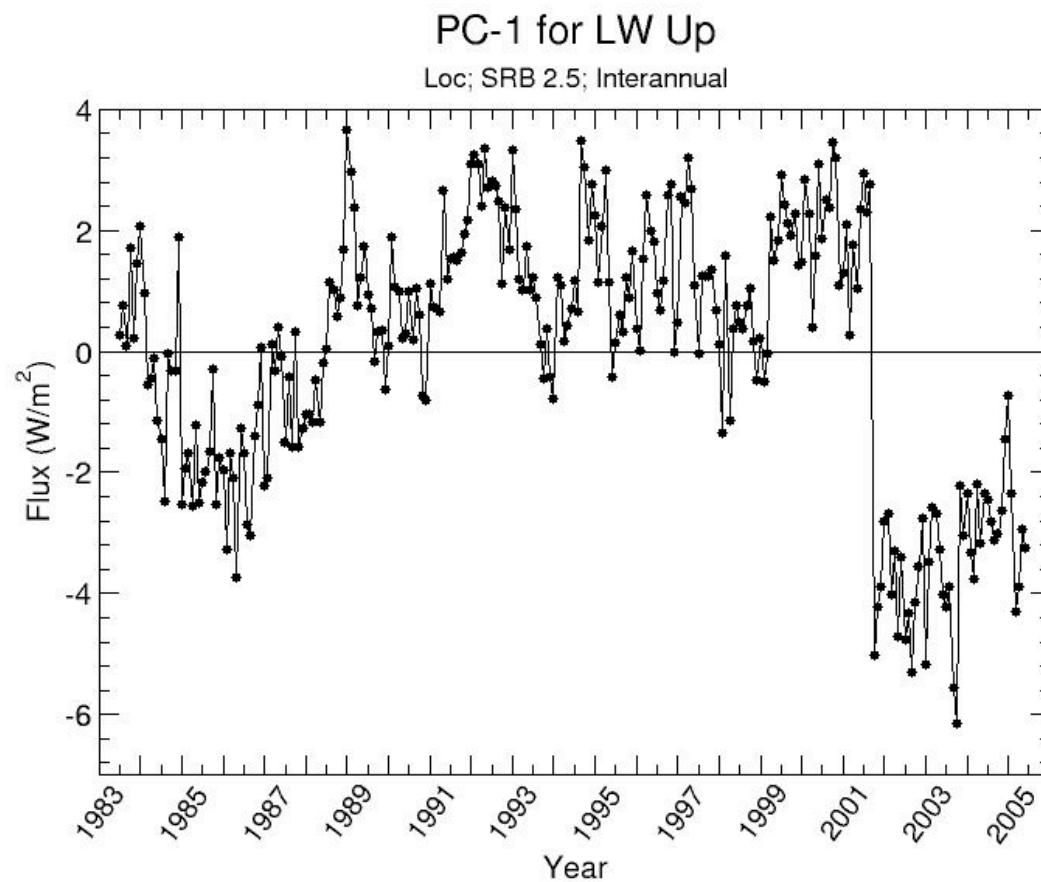


EOF-4 Longwave Down

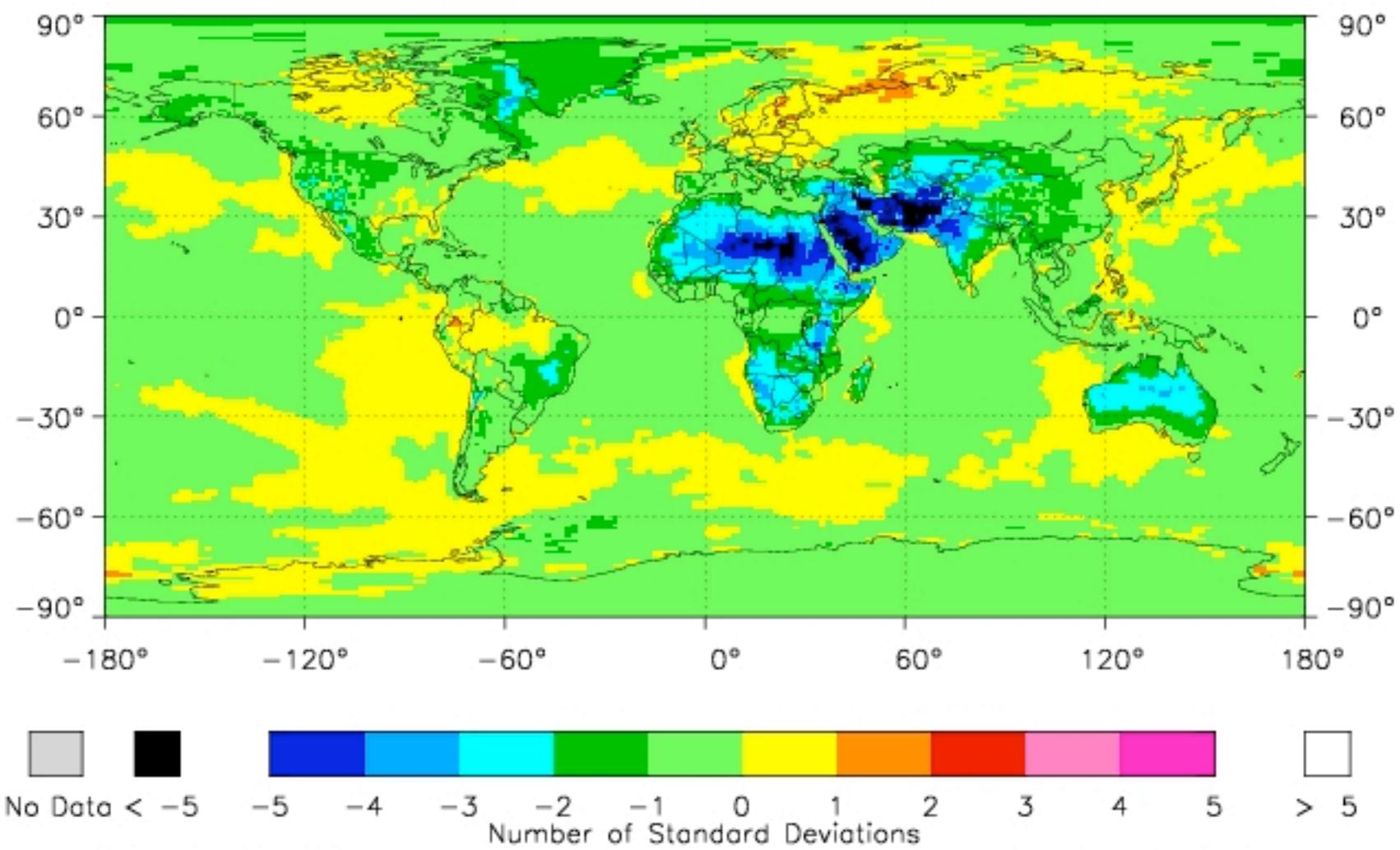


Artifacts: EOF-2 Shortwave Down





EOF-1 Longwave Up



Conclusions

- There are about 40 variations discernable in SWD, LWU and LWD.
- For SWD, EOF-1 and -3 describe ENSOs.
- Artifacts are clearly shown, especially due to Satellite availability.
- Indian Ocean activity is strong (IOD?)
- SWD EOF-8 shows variations of clouds near Brazil.

Conclusions (Continued)

- LWD EOF-4 and LWU EOF-5 and -7 show North American/Central Eurasia Dipole.
- LWU EOF-8 shows Europe/Asia Dipole.
- Near Equator lack of Coriolis Force results in small variations of Pressure Heights, so that SWD and LWD are more sensitive to processes than Pressures.

Future Work

- Evaluate effects of TOVS operational sounding algorithm changes and ISCCP skin temperature retrievals.
- Evaluate effects of Observing System changes.